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ASTRONOMICAL SOCIETY OF LONDON.

February 12, 1830. No. 25.

Report of the Council of the Society to the Tenth Annual General Meeting, held this day.

Your Council have the pleasure to announce in this, the Tenth Annual, Report, the increasing prosperity, efficiency, and consideration of the Astronomical Society.

The following abstract of the receipts and expenditure during the preceding year, will shew the present state of the funds of the Society; viz.:—

Receipts.	£.	*s.*	*d.*
Balance of last year	335	3	3
Arrears, Feb. 1829:—			
Resident members	62	15	0
Non-resident ditto	33	12	0
Contributions for 1829-30;—			
8 admission fees	11	11	0
Resident members	161	14	0
3 non-resident ditto	25	4	0
1 non-resident fee	4	4	0
1 composition	21	0	0
1 year's dividend on 800*l.* consols	24	0	0
1 yr.'s do. on 857*l.* 13*s.* 8*d.* new 4 per cents	34	6	0
By sale of the memoirs	45	2	0
	£758	11	3

Expenditure.	£.	*s.*	*d.*
Printer's bill for Vol. III. Part II.	270	14	7
Robinson's bill, last year	22	5	0
Repairs of instruments	15	12	0
Lithographer's bills	8	0	0
Engraver's bills	2	13	6
1 year's rent to Michaelmas	52	10	0
Commission to collector	17	10	0
Sundry disbursements for porterage, postage, &c, including an arrear due to former Secretary	38	3	9
Balance	331	2	5
	£758	11	3

And the assets and present property of the Society are as follow; viz.:—

Assets of the Society.

	£.	*s.*	*d.*
Balance in the hands of the Treasurer	286	2	5
Due from Messrs. Baldwin and Co. booksellers, about	50	0	0
Due from Messrs. Priestley and Weale, booksellers, about	70	0	0
Arrears, Feb. 1830:—			
2 contributions of four years' standing	16	16	0
3 ——— of three ditto	18	18	0
10 ——— of two ditto	42	0	0
8 ——— of the past year	16	16	0
1 change of residence	4	4	0
5 non-resident members	42	0	0
	£546	16	5

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800*l.* stock in the 3 per cent. Consols.... 857*l.* 13*s.* 8*d.* ditto in new 4 per cents... } valued at about	1600	0	0
Books unsold, now in hand.......			
Various astronomical instruments			
Eleven silver medals unappropriated..........................			
From the above, however, are to be deducted—			
The printer's bill for Vol. IV. Part I. now in progress			
———————— sundries................	24	5	8
Cost of three gold medals omitted to be carried to account	30	7	6
A few sundries, estimated at about............................	20	0	0

Agreeably to the fundamental Rules of the Society, no bills above the amount of five pounds can be paid by the Treasurer, without having been previously examined and approved of by the Council; and the annual accounts are afterwards again examined, prior to the General Meeting, by a Committee appointed for that purpose. All the documents are deposited with the Secretary, and may be inspected by any member of the Society.

The progress and present state of the Society with regard to the number of its members and associates, may be seen from the following abstract, continued from the Report of last year; viz.:—

	Compounded.	Resident.	Non-resident.	Honorary.	Total Members.	Associates.	Grand Total.
Feb. 1829 . .	40	92	99	1	232	32	264
Since elected	1	9	9	—	19	2	21
Since lost . .	—	6	2	—	8	—	8
Feb. 1830. .	41	95	106	1	243	34	277

Amongst the deaths, the Society have to regret the loss of Mr. Edgeworth, a gentleman of the highest promise and attainment, and worthy of a name dear to science and to literature.

The exquisite transit circle by Troughton, of two feet diameter, presented by Dr. Lee, is now in the possession of Captain Smyth, after receiving from the hands of its maker some important additions and improvements. Upon these much time was necessarily expended, and since the instrument was placed in the Bedford Observatory, the weather has not allowed Captain Smyth to prosecute the delicate researches in which he is engaged. The Society will have remarked with satisfaction the excellent observations of occulted stars by this active astronomer, and by Mr. Maclear, to whom Dr. Wollaston's telescope was intrusted. The transit clock presented by Lieutenant Beaufoy, and now in the possession of Mr. Herschel, has been lent to the Rev. Michael Ward, and will be forwarded to him by the first opportunity. The Beaufoy circle has

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been safely received, but too recently to have enabled Mr. Ward to furnish the observations which may be expected from his zeal and attainments.

A library has been formed, of considerable extent and value, from the contributions of individuals and scientific bodies. The want of any means of consulting this has long been felt; but the Council have the gratification of stating, that Professor De Morgan has offered his valuable services to arrange and catalogue the books and manuscripts belonging to the Society, a task which is now nearly completed. It is well known that the Council have long been endeavouring to procure more convenient apartments for the use of the Society, such as would be better adapted to their increasing demands, and under a more permanent tenure than those which they now hold. It is to be regretted that so desirable an object has not hitherto been attained.

Upon the increasing attention paid to our noble science, it is scarcely possible to speak in terms too flattering. In addition to the increased activity of public observatories, the exertions of private individuals are by no means slackened in this race of improvement. A magnificent achromatic object-glass, the masterpiece of Cauchoix, and of the largest dimensions, having 11¾ inches clear aperture, and 19 feet focal length, has been purchased by our spirited President. The task of mounting this gigantic telescope equatorially, has been undertaken by the most celebrated of our modern artists, and we may hope to see this active astronomer speedily engaged in pursuing, with unequalled means and unabated ardour, the path of discovery in which he is already so advantageously known.*

Your Council trust, that they have not been backward in promoting, to the utmost of their power, every attempt to advance the interests of the science of Astronomy.

Before the departure of Captain Ross on his Arctic expedition, that enterprising officer proposed to make any scientific observations, for which his situation might be considered favourable,

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* [Although this telescope was placed on a temporary stand, at the President's Observatory at Kensington, on January 29, the weather did not permit of any trial of its powers *previously* to the anniversary. It may now, therefore, be interesting to state, that the first night on which an opportunity was afforded, viz. the 13th of February, Mr. Herschel discovered a *sixth* star in the trapezium in the nebula of Orion, a few degrees south following of, and about five or six seconds distant from, the star denominated A in that trapezium, in Mr. South's observations of the double stars. Its brightness is about one-third of that of the fifth star, discovered by M. Struve, which is as distinctly seen as the companion to Polaris is in a five-feet achromatic. It was immediately after detected by Mr. South, and has since been seen by Mr. Baily, Mr. Troughton, Mr. Sharpe, and others, and repeatedly by myself. Saturn, with his Belts, Double Ring, and Seven Satellites, is beautifully defined, with powers of 130, 280, and 350. The object-glass is not in very perfect adjustment; it was placed in its cell, as now used, by mere accident, and, in consequence of unfavourable weather, it has not been deemed prudent hitherto to attempt any alteration.—W. S. S. *Sec.*]

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should he unfortunately be detained upon his perilous route. An application was made by him to the Lords of the Admiralty, and supported by your Council, for a loan of the requisite instruments, which was received by their Lordships in a most gratifying manner. Captain Ross was amply supplied with the proper instruments; and, at the request of the Council, a list of moon-culminating stars, for the months of January, February, March, and April, 1831, was prepared for him by Mr. Henderson, the Astronomer Royal having undertaken that the corresponding observations should be made at Greenwich.

The numerous and excellent observations of Aldebaran, during the preceding year, which have been already communicated, are a satisfactory proof of the increased interest felt for the science, and of the importance attached to the views and wishes of the Society. In some instances the star disappeared instantaneously after the bisection of its disc by the moon's limb, while in others the projection lasted nearly six seconds. It does not appear that a sensible diminution of brightness was perceived previous to immersion. When a sufficient number of well-attested appearances has been collected, it may be possible to account for the anomalies which have hitherto been so perplexing. The attention of astronomers towards this interesting phenomenon is earnestly requested during the present year. Neither should the predicted occultations of other stars be neglected by observers. It is from them that the most accurate determinations of longitude are, in the generality of cases, to be obtained; and the tedious difficulties with which they were embarrassed, have been in a great measure removed. The Council have distributed from time to time monthly notices of the principal lunar occultations, for the meridian of Greenwich, computed by Mr. Henderson, to whom this branch of astronomy is under peculiar obligations. It is to be regretted that the avocations of this gentleman will not allow him to continue these useful lists much longer. Fortunately, this loss is greatly diminished by a recent memoir due to our excellent associate Professor Bessel, and inserted in *Encke's Ephemeris* for 1831, which gives a short and simple method of transferring to another meridian the time and circumstances of an occultation already computed for Berlin, along with the quantities required for the calculation. These subsidiary quantities have been prepared for the first six months of the present year by Professor Troeger of Dantzic, and inserted in the *Astronomische Nachrichten*, an early copy of which was transmitted to the Society by the accomplished editor. This has been printed for distribution, in the hope that the zeal of Mr. Henderson will find worthy successors. To mark their sense of obligation to this gentleman, and as a small tribute of respect, the Council have unanimously agreed, "That it be recommended to the general meeting to present to Mr. Henderson a copy of the Memoirs, handsomely bound, for the very valuable assistance which he has rendered to the cause of Astronomy

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in his various computations presented to the Society."* The numerous communications that have from time to time been received from Germany, and the valuable astronomical works that are constantly issuing from the press of that country, render an acquaintance with the German language almost essential to the prosecution of the science. The difficulty which the Council would otherwise have experienced has been greatly removed by the cordial and very valuable assistance of a gentleman deeply versed in every branch of the science, who has, on all occasions, been ready in favouring the Council with translations of such papers as they have from time to time required. To mark their sense also of this obligation, and as a small tribute of respect, they have agreed, "That it be recommended to the general meeting to present to Dr. Tiarks a copy of the Memoirs, handsomely bound, for his kind and ready assistance at all times in translating various foreign papers for the use of the members, and for other valuable services rendered to the Society."*

A simple and ingenious method of determining the mass of the moon, by observing the R.A. of the bright limb of Venus, has been proposed by Professor Airy, with a request that the Society would use their influence in obtaining for it an extensive circulation. Copies have, accordingly, been forwarded to every public and private observatory in Europe, with a strong recommendation for its adoption.

The fluctuating use of symbols in mathematical investigations more frequently occasions mistake and misapprehension than the inherent difficulty of the subject matter; and it is to be lamented that so little care is taken by the generality of authors to be consistent with each other, or even with themselves. An attempt has been made by Mr. Lubbock, under the auspices of the Society, to introduce a system of notation depending upon fixed rules. This paper is now in the press, and will be submitted before publication to the geometers of this and other countries. In this way, it seems probable that a considerable degree of accordance may be obtained, which it is hoped may be strengthened and confirmed by the sanction and practice of the Society.

The paper upon the Constant of Aberration, by Mr. William Richardson, to which such marked attention was drawn in the Report of last year, has subsequently been published in the Memoirs of the Society, and fully justified the high expectations excited. The immense labour bestowed upon this important investigation, the clearness with which it is developed, and the number of observations on which it is founded, must command the admiration of all astronomers. Your Council have unanimously awarded to Mr. Richardson the gold medal for the determination of this fundamental constant.

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* [The recommendation of the Council in each of these instances was unanimously approved of, and adopted by, the Members at the General Meeting.—*Sec.*]

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A gold medal has also been voted to Professor Encke for the superb Ephemeris of Berlin. It would be superfluous to dwell here upon the merits of this well-known work, which, far outstripping all rivalry, must be considered as the only ephemeris on a level with the present wants of the science,—the manual and standard of practical astronomy wherever it may be cultivated.

The President will deliver the medals at the close of this meeting in the accustomed form.

Your Council trust that this exposition of the resources and progress of the Society will be satisfactory to the members at large; but it is not to be forgotten, that much remains to be done, and that more labourers are demanded. It is not sufficient to thank or to admire those who have toiled in the good cause,—the necessity of imitation must be strongly felt and inculcated. There is scarcely any instrument which may not be usefully employed, or any acquirements which may not perform good service. Phenomena may be predicted, preliminary computations furnished, reductions prepared, with little more knowledge than that of common arithmetic; occultations, eclipses, moon-culminating stars, planets, may be observed, and portions of the heavens examined and surveyed, with instruments of moderate price and of inferior dimensions. Indeed, in the present state of astronomy, the class of *differential observations* embraces far the greater portion of celestial phenomena even for the best instruments; and by the publication of the Berlin Ephemeris, computation is almost wholly reduced to simple interpolation. At no distant period it may be possible for the Council to provide skeleton forms, not merely for registering observations, but for their reduction and for all ordinary calculations.

It would also be highly desirable to collect and publish annually, in a condensed form, observations presented to them by British and foreign astronomers, and not printed elsewhere,—a repository and digest of the services of amateur observers. The Council confidently rely upon the energy and activity of the members, and of all friends to astronomical science, for the accomplishment of this important object. Thus, not only will a large mass of valuable information be rescued from oblivion, and preserved in a shape the best adapted to comparison and use, but a deeper interest will be felt by the contributor, and a stronger motive offered for that care and method, without which computation is rendered useless, and instruments degenerate into toys.

(*The President then addressed the Meeting on the subject of the award of the Medals, as follows:*—)

GENTLEMEN,—Ere we proceed to the distribution of our honorary rewards, I cannot but congratulate you on the general state of astronomical affairs: whether we turn to the north or to the south, to the east or to the west, the astronomical horizon presents a more promising aspect than it has done for many years; and what is peculiarly gratifying to us is, that amidst the general endeavours to advance

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astronomical knowledge, our own country this year stands indeed conspicuous. Since our last anniversary, the observations of Professor Airy have done honour to the University of Cambridge; those of Dr. Robinson have rewarded the munificence of the Primate of Ireland; and others made at Paramatta, in the observatory founded by Sir Thomas Brisbane, and which (thanks principally to the exertions of members of this Society) is now become an observatory in the service of the British government, give us an earnest of the value of those observations of Sir Thomas's, now in the course of reduction by Mr. Richardson, as also of the importance of others, which, on the authority of the government, we are henceforth regularly to receive from Paramatta. Again, within these few days has arrived a first series of standard transit observations, made by Mr. Fallows at the Cape Observatory. They are, as yet, unpublished. Knowing him, however, intimately as I do, and having witnessed his early astronomical career, I may be permitted to felicitate you on their arrival, confident that whatever comes from him will be honourable to his country, for it will be worthy of himself. But that these observatories have rendered to us their first fruits, is not all: others are in a state fast approaching to practical utility; and when another year shall glide away, he who shall have the honour to fill the chair I now so unworthily occupy, will have, I hope, to applaud the activity of the observatories of Brussels and Cadiz, of Cracow and of Edinburgh, of Geneva and Madras.*

While exulting, however, in the accession of these new observatories, let us not forget honourably to notice, that from the Royal Observatory of Greenwich has issued, but a few weeks since, a Catalogue of 720 Stars;—a valuable treasure, and for which the astronomical world is indebted to this Society, as well as to the Astronomer Royal; inasmuch as the stars it embraces have been selected from, and reduced by, the Society's Catalogue. On examining the important facts resulting from this first series, and which the Astronomer Royal has exhibited by actual comparison with our own work, let us hope, now that his fundamental catalogue has reached a degree of accuracy probably unexampled in astronomical history, he will persevere in the task; assured as he may be, that no one thing would tend more to the credit of the Observatory, and to his own glory, than that his name should be attached to a large catalogue of stars, called, as in the good old times of Flamsteed, "*The British Catalogue.*"

The Royal Observatory of Paris is also an object of increasing interest; a splendid equatorial by Gambey has been added to its previous collection; and the transit instrument by the same distinguished artist, so long and so anxiously looked for by our *confrères*

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* This is not literally a new observatory; the instruments, however, now about to be sent thither, are so far superior to those already there, that it may almost be regarded as a new establishment. The same applies to the Geneva observatory, but with greater force; for not only are superior instruments ordered for it, but a new building is being prepared for their reception.

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of Paris, is at length placed on its piers; whilst the Observatory, *properly* so called, is about to be remodelled and rendered more convenient for astronomical labour. We hail the recommencement of the observations as an era which will be worthy of the country of Cassini,* of La Caille, and of La Lande;—of La Grange, Legendre, and La Place. The sentiments of the late distinguished Secretary of the Institute, that "*Ce n'est pas le tout que de fonder un observatoire et de doter l'astronome, il faudrait faire un fonds annuel pour l'impression, et imposer à l'astronome l'obligation de n'être jamais en retard d'une année,*"† being adopted by the astronomers of Paris, we shall not have to regret that observations, made with such instruments and by such men, shall be available only to those who reside within the walls of the observatory. We have this year set our Parisian friends a splendid example, and doubtless they will follow it.

As to the improvement of the achromatic telescope, since our last anniversary, much cannot be said. The theory of Mr. Rogers has not, as far as I know, been put to the test of practice, in a manner at all commensurate with its merits; whilst Mr. Barlow's achromatic, of eight inches aperture and eleven feet focal length, owing to imperfections in the material of its exterior lens, does not define close sidereal objects so neatly as might be wished, but is, nevertheless, applicable to many useful purposes; and there is a hope that the labours of a sister society, although hitherto unsuccessful in furnishing us with the mode of making good *flint* glass, will shortly put us in possession of at least a succedaneum for it.

Some of the members‡ of the Society, regretting that the late Board of Longitude was not remodelled instead of being dissolved, had, during the last spring, several interviews with His Majesty's ministers on the subject of a new one. A plan for the constitution and regulation of a new Board was shewn to the First Lord of the Admiralty; and was *only* not introduced to the consideration of Parliament at the instance of the projectors of it, in consequence of a wish expressed by Lord Melville, that a bill drawn up in its spirit should be presented to the Legislature by the Admiralty officers. The question which at that time, and during the remainder of the session, so completely engrossed the attention of the government, being now disposed of, let us hope, that the pledge then given will be remembered, and that on our next anniversary we shall have to thank the government for having given us a Board of Longitude, which shall be worthy of the first maritime nation in the world.

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* Cassini was an Italian professor; he was, however, called to Paris by Colbert, whose comprehensive mind felt that not only military success, but scientific reputation could confer glory on his country. Not only did he place the observatory of Paris under the care of Cassini, but men of all countries who had distinguished themselves by their scientific acquirements were invited by that illustrious patron of science to reside in Paris. He was also the founder of the Académie des Sciences, and of the Observatory of Paris.

† Hist. de l'Astron. au XVIIIème siècle; par Delambre, p. 115.

‡ Lord Ashley, Mr. Francis Baily, Captain Beaufort, and the President.

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As connected in some measure with astronomy, we see the geodetic operations in Ireland carried on with vigour, under the superintendence of Colonel Colby; whilst for triangulating our Indian empire (thanks to the scientific spirit of the Directors of the East India Company), such a battery of field apparatus is nearly prepared by Troughton and Simms, as, in even less able hands than those of Captain Everest, could scarcely fail to immortalise him who should have the happiness of using it.

Again, we have the pendulum investigations of our associate, Professor Bessel, shewing that the corrections employed by British philosophers for the reduction to a vacuum are far from accurate; and, to come nearer home, our ever active member, Mr. Francis Baily, has demonstrated that certain imperfections and discordances exist in the apparatus employed by previous experimenters, which point out the absolute necessity of fresh inquiries being instituted, ere we can pretend to be possessed of accurate estimations either of measure or of weight.*

But our Society was not founded solely for the investigation of astronomical refinements—practical utility was to go hand in hand with it: geography was to be improved; and hydrography, so essential to the well being of our maritime country, was not to be neglected. To advance our knowledge of the former since our last anniversary, British intrepidity, undaunted by previous defeat, has left our shores, and is now struggling in the Victory to achieve that, which the perseverance of a Parry, backed by the exchequer of Great Britain, was forced, after repeated trials, to abandon in despair. And the no less interesting part of the history is, that the expense of the attempt (which God grant may be successful!) has been defrayed by the princely liberality of an English gentleman, whose modesty withholds his name from the public.

Again, as to hydrography: scientific surveys are gradually spreading to every quarter of the globe, under the influence of the noble Lord who has lately enrolled his name in this Society. But little does it matter if coasts are well surveyed, rocks detected, shoals discovered and currents ascertained, if the results are not digested so as to be practically useful to the seaman. It gives me pleasure, therefore, to announce, that since we last met, an appointment has been made by the Admiralty, which has given universal satisfaction; for it assures us, that the day is not far distant, when an Englishman shall visit the hydrographic department of the *Depôt de la Marine* of a neighbouring state, without feelings humiliated by the comparative inferiority of the corresponding establishment of his own country.

Proceed we now to the distribution of our medals. By the minutes read at the table, you have been informed that "one of them

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* A standard measure, on a new construction, has been ordered by the Council, since the delivery of this address, and is now in course of completion by Troughton and Simms.

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has been decreed to Mr. Richardson for his investigation and determination of the constant of aberration, from observations made at Greenwich with the two mural circles; the other to Professor Encke, for his *Berlin Ephemeris.*"

Three hundred years have now elapsed since Copernicus proposed to the world that system which bears his name; and if we except the labours of Tycho Brahe, who, besides a catalogue of 800 stars, made attempts to determine the altitude of the pole-star at different seasons of the year, little was done by practical observation to support or refute the ideas of Copernicus till the time of Galileo. Observations of the eclipses of Jupiter's satellites induced him to propose them as a means of determining differences of longitude, whilst his discovery of the phases of Venus removed a serious objection to the truth of the Copernican system, and which Copernicus himself predicted would be removed, though he had not the means of doing so himself. About the year 1665, Huygens, by his discovery of the pendulum clock, gave to astronomical observations an accuracy hitherto unknown; and Cassini, by means of the excellent glasses of Campani, accumulated a vast mass of observations of the eclipses of Jupiter's satellites, and deduced from them tables whereby astronomers could predict their occurrence.

Notwithstanding the powerful arguments advanced in its favour, the Copernican hypothesis was not generally embraced; for in the year 1669, nearly a century and a half subsequent to its promulgation by Copernicus, even the celebrated Hook, to use his own words, "would not absolutely declare for it."* To settle the matter, therefore, this extraordinary man, feeling that the instruments of Tycho, although magnificent beyond all others, were, from the nature of their construction, and from their being unprovided with telescopic sights, incompetent to detect minute alterations of sidereal positions, and knowing that the laws which governed refraction were so little understood† as to render all observations in which that element was materially involved, liable to errors greater probably than the quantities he was in search of, invented the zenith sector. It was erected at Gresham College, and consisted of a telescope 36 feet long, a divided arc, and a plumb-line. The star selected for observation, and with reference to which, indeed, his instrument was entirely constructed, was one which passed within two or three minutes of the zenith of Gresham College, was visible in the day-time throughout the year, and was γ *Draconis:* by observing its zenith distance when the earth was in opposite points of her orbit, he found (as he erroneously concluded) a sensible parallax, amounting to about 20 seconds, and, consequently, determined that the Copernican system was the true one.‡

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* An Attempt to prove the Motion of the Earth, from Observations made by Robert Hook, F.R.S., pp. 5 and 7.

† Idem, pp. 10 and 11.

‡ An Attempt to prove the Motion of the Earth, from Observations made by Robert Hook, F.R.S., p. 25.

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In the mean time, the eclipses of Jupiter's satellites, thanks to the facilities of predicting them afforded by Cassini's tables, had been assiduously observed; and in the year 1675, the discordances found between the predicted and the observed eclipses enabled the celebrated Roëmer to demonstrate that light was not instantaneously propagated, and that the discordances between the tables and the observations might be considered as the measure of its velocity.

The year of Roëmer's discovery was further marked by another epoch in astronomical history, namely, the foundation of the Royal Observatory. Flamsteed, with his mural quadrant, detected a change of place in the pole-star, amounting to 35, 40, or 45 seconds, attributed it to parallax, and regarded it as confirmatory of Hook's discovery. Indeed, the observations of Hook, as well as of those who preceded him, although nominally in search of parallax, had for their object little else than the confirmation or verification of the Copernican system; and this arrived at, there seems to have been but little disposition to repeat them.

Hence it was that the brilliant discoveries of Newton having placed the accuracy of the Copernican system beyond all possibility of doubt, the investigation of parallax was not resumed till the latter end of November, in the year 1725, at which time Molyneux erected his 24-feet zenith sector, by Graham, in his observatory at Kew.* "On the 3d of December, γ Draconis was, for the first time, observed as it passed near the zenith, and its situation carefully taken with the instrument; and again, on the 5th, 11th, and 12th, when, no material change in the star's place having been detected, further observations seemed needless, since it was a time of the year when no sensible alteration of parallax could soon be expected." Bradley, however, being on a visit to his friend Molyneux, was "tempted by curiosity to repeat the observation on the 17th, and perceived the star pass a little more southerly than when it had been observed before:" suspecting that the apparent change of place might be owing to erroneous observation, it was observed again on the 20th, and he found the star still farther south than in the preceding observations. This sensible alteration surprised himself and Molyneux, inasmuch as it was the contrary way from which it would have been, had it proceeded from an annual parallax of the star; but being incapable of accounting for it by want of exactness in the observations, and having no notion of any other cause from which such apparent motion could proceed, they suspected that some change in the materials of the instrument itself might have occasioned it. Under this apprehension they remained some time, but being at length fully convinced, by repeated trials, of the great exactness of the instrument, and finding, by the gradual increase of the star's distance from the pole, that there must be some regular cause which produced it, they

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* Philosophical Transactions, vol. xxxv. p. 639.

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examined nicely at the time of each observation how much it was; and about the beginning of March 1726, the star was found to be 20″ more southerly than at the time of the first observation. It now, indeed, seemed to have arrived at its utmost limit southward; for in several observations made about this time, no sensible difference could be detected in its situation. By the middle of April it appeared to be returning towards the north, and about the beginning of June it passed at the same distance from the zenith as it had done in December, when it was first observed. From the quick change in the star's declination about this time (it increasing a second in three days) they concluded that it would now proceed northward, as it before had gone southward of its present situation; and it happened as was conjectured; for it continued to move northward till September following, when it again became stationary, being then near 20″ more northerly than in June, and no less than 39″ more northerly than it had been in March. From September it returned towards the south, till it arrived, in December, at the very same situation it had been at that time twelve months, allowing for the difference of declination "on account of the precession of the equinox."

Such is a brief history of the Kew observations; commenced, indeed, for the determination of sensible parallax, but which, as subsequently in the hands of Herschel, led to a very different result. In reading it, we are at a loss whether most to admire the mode in which the observations were conducted, or the modest unassuming manner in which they are recorded: no possible source of error is allowed to pass without the most rigid examination—no theory suffered to embarrass the observers in their observations; the slightest anomaly became the subject of suspicion, till in presumed anomaly was found the most perfect regularity.

That observations so conducted, leading to results so unexpected, could be abandoned till the law which governed them should be unfolded, was impossible. But Bradley rejected all inquiries into the cause till the effects were accurately determined; and feeling that the apparent motion was obtained by observations only of one year—by one instrument—and by one star,—he erected at Wanstead, aided by his friend Graham, on the 19th of August 1727, his zenith sector of 12½ feet focus, formed, indeed, upon the same general plan of Molyneux's, but furnished with a divided arc of 6¼ degrees on each side of the zenith point, for the purpose of enabling him to ascertain, by direct observation, whether other stars than γ *Draconis*, would be similarly affected. The instrument's situation, when adjusted, "might be securely depended upon to half a second," and its telescope could be directed to "not less than 12 stars, bright enough to be seen in the day-time" throughout the year: the same changes were observed as had been previously detected with Molyneux's instrument. Inflexible, however, in his resolution not to generalise till sufficient means were collected to lead him to a "probably just conclusion," the year of

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probation was suffered to be completed before "the observations were examined and compared:" *then* it was that he satisfied himself of the general laws of the phenomena; and *then*, and not *till then*, did he endeavour to find out their cause. Convinced that the apparent motion of the stars which he had observed was not owing to nutation—persuaded that a change in the direction of the plumb-line with which the instrument was rectified, was insufficient to have occasioned it—and having appealed unsuccessfully to refraction,—he perceived "that if light was propagated in time, the apparent place of a fixed object would not be the same when the eye is at rest as when it is moving in any other direction than that of the line passing through the eye and the object; and that when the eye is moving in different directions, the apparent place of the object would be different." He therefore announced his discovery in these words: "That all the phenomena proceeded from the progressive motion of light and the earth's annual motion in its orbit," or, as he afterwards called it, aberration of light.

But he who determined its existence determined also its constant, and fixed it at 20″; giving us, therefore, the interval of time in which light travels from the sun to the earth, as eight minutes and seven seconds, differing from that deduced by Roëmer nearly three minutes of time, a circumstance not at all to the discredit of Roëmer, considering the imperfect knowledge of the theory of Jupiter's satellites at the time he made his important discovery.

The observations, however, which led Bradley to the discovery of aberration, and to the determination of its constant, being as yet unpublished, have given rise to insinuations certainly ungenerous, and probably unjust. Impelled by more honourable feelings, our illustrious associate Bessel, alluding to the observations of γ *Draconis* made by Bradley when the sector was removed to Greenwich, says,* "*Cæterùm Bradleii observationes Wansteadianæ liberari possunt à sectoris mutabilitate, quum sæpiùs, eodem tempore, observatæ sint stellæ, in quibus aberrationi contraria fuerunt signa: quâ de causâ, et propter observationum præstantiam, optabile esset reperire ipsa Bradleii autographa.*" It will, therefore, be highly grateful to him, and to astronomers in general, to be informed from this chair, that the manuscripts of the Wanstead observations are found!—that, to the honour of the University of Oxford, twenty-three sheets of them are already printed; and that the volume will be presented to the public with as little delay as possible, under the superintendence of Professor Rigaud.

Till within these few years, the constant, as determined by Bradley, was universally employed in all our astronomical reductions; recently, however, astronomers have re-investigated it. Delambre, from the eclipses of Jupiter's satellites, regards it as 20″,25. Bessel, from Bradley's observations made at the Royal Observatory, after he was appointed Astronomer Royal, has deduced for the constant 20″,68. Lindenau, by comparisons of Bradley's, Maskelyne's, Bessel's, and Pond's observations of *Polaris*, has obtained for it 20″,61. Brinkley, from his own observations, considers it as 20″,37. Whilst Struve, by his observations, draws almost the same inference, namely 20″,35.

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* Fundamenta Astronomiæ, p. 124.

Such were the results most entitled to our confidence, when Mr. Richardson, in the hours allotted to him for repose or recreation, undertook those labours which form the subject of our present consideration, and of which the following is a brief outline. A second mural circle by Jones, after the model of that of Troughton's, having been erected at the Royal Observatory, in the April of 1825, corresponding observations with the two instruments were carried on simultaneously; they were confined, indeed, to a few stars, but every precaution to render them as accurate as possible was adopted. Thus, the index error of each instrument was ascertained by observing the same star alternately, by direct vision and reflection; each pair, therefore, giving to its respective instrument one horizontal point perfectly independent of astronomical tables, the final accuracy of the determination of the index error being directly as the number of pairs observed. Throughout the observations, the place of each star was arrived at by reference to the six microscopes of each circle; care also being taken to equalise, as nearly as possible, the temperature of the observatory with that of the external air, so that errors to any extent, arising from partial expansions or erroneous divisions of the instrument, were effectually excluded.

From such unexceptionable data, fourteen stars were selected by Mr. Richardson as the fittest for his purpose, being those the least affected by refraction, and the most affected by aberration, so that the errors of observation might have the minimum influence upon the results. Upwards of 4,000 observations he separately discussed, and in no instance was the actual aberration of each observed star less than 14″; and the conclusion to which he has arrived is, from Troughton's circle, that the Constant of Aberration is 20″,505; whilst by Jones's it is 20″,502, the one differing from the other but three-thousandths of a second.

Hook, in searching for parallax, was misled by his instrument. Bradley, in detecting it, was unsuccessful, but discovered aberration. Hook's instrument was the work of his own hands; Bradley's was the work of Graham. Sensible that much of his astronomical glory was referable to the accuracy of his instrument, the amateur astronomer of Wanstead was ever ready to acknowledge it; and when we consider that one hundred years' improvement in astronomical manipulations can alter the constant of aberration as determined by him but one half second,* we are almost led to exclaim " *quando ullum inveniemus parem ?*"

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* It is not impossible that much of this discordance will disappear when the Wanstead Observations shall be reduced with modern precision.

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Our Graham is amongst us; to him we are indebted for the instruments with which results thus important have been obtained, and also for the mode of using them, through which the maximum of accuracy has been acquired. One of them was made with his own hands, the other under his direction; and it is not too much to say, that the disciple has shewn himself worthy of his master. The benefits which Edward Troughton has conferred on science, are too well known to need enumeration. His Majesty the King of Denmark, not insensible to the importance of science, and feeling that for much of the accuracy to which astronomy and navigation have arrived, we are indebted to the genius of our revered member, has recently acknowledged his gratitude to him, by the presentation of his gold medal, inscribed with the word "MERITO." Never was inscription more appropriate. May he live long to enjoy this token of respect! alike honourable to himself and to the princely feelings of its royal donor.

On looking over the constant as determined by each star, nothing definitive, as Mr. Richardson justly observes, can be concluded, as to whether light emitted from different stars is propagated to us with different degrees of velocity: the idea is not irrational, but its validity future astronomers must determine.

(*The President then, addressing Mr. Richardson, continued thus:*—)

Mr. Richardson,—Brought up to an employment little allied to astronomy—residing in a part of the country remote from the metropolis—cut off from the society of scientific men, which operates so powerfully in stimulating to scientific exertions,—we see you quitting the place of your birth,—leaving the roof of your respected parents,—and presenting yourself in this great city, known only to a single individual; abandoning every sordid pursuit to follow that which, however noble, too often leads, in this country, to neglect and poverty—we find you, in August 1822, at the Royal Observatory as an assistant. Here you soon distinguished yourself by your punctuality—your attention—and your zeal; accustomed to the business of an observatory,* you required to be instructed only in the established routine of that to which you were appointed. Soon did you gain the confidence of the Astronomer Royal; and whether he wished to establish the place of a star in the heavens, or of a spot on the earth, to no one could he intrust the one or the other with more confidence than to you, whom he emphatically styled "his right hand." Attached to astronomy, but unable to maintain your family upon the *miserable* pittance allowed you by the government, we see you observing all day and computing all night. As an assistant of the Royal Observatory, I have only to say,—Go on as you have begun. But if a trust higher in the scale of importance awaits you, remember, sir, that you have *now* a character

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* The President's.

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to maintain; for your name, but a few years since confined to the narrow limits of a country village, is now known throughout Europe; and that too by your own exertions. Receive this medal, sir, as a pledge of our esteem—as, indeed, the highest honour we have to offer. May it stimulate you to fresh exertions in the cause of your favourite science; and on your return from India to your native home, may the Astronomer of Madras be as honourably distinguished, as is this day the Assistant of the Royal Observatory.

(*The President then resumed his address to the Members, as follows:*—)

The second medal has been adjudged to Professor Encke, for the *Berlin Ephemeris* which bears his name. Experience has long shewn, that an astronomical ephemeris is almost as necessary an appendage to an observatory as are the instruments themselves; accordingly we find that some one, more or less perfect, has been in the hands of every astronomer, since astronomy has been pursued in a systematic manner. The first which appears in this country at all deserving the name of an astronomical ephemeris was that of Vincent Wing, and was used by Flamsteed: it, however, was very imperfect, and Flamsteed, whilst at Derby, transmitted to the Royal Society supplements to it, containing notices of phenomena not inserted in *Wing's Ephemeris*, and which were published from time to time in the *Philosophical Transactions*. La Caille, about the year 1755, proposed one upon a larger scale; but in 1767, on the recommendation of Dr. Maskelyne, the Board of Longitude of Great Britain published the *Nautical Almanac and Astronomical Ephemeris*, Dr. Maskelyne himself taking the superintendence of it. Its object was evidently twofold, since it contained, even when first published, much information not wanted by the astronomer, and still *more* not required by the seaman. The *Connoissance des Tems* also was published much in the same style, and was, as well as the *Nautical Almanac*, a manual not only for the seaman, but also for the astronomer. The *Berlin Ephemeris* was purely astronomical, but, like the *Connoissance des Tems*, contained, in the shape of additions, much valuable astronomical information, inserted by its highly respected editor, the much-lamented Bode. But the *Connoissance des Tems*, compared with the *Nautical Almanac*, had so fallen into disrepute, that, in the year 1795, Grégoire, now Evêque de Blois, in the name of the Committees of Marine, of Finance, and of Public Instruction, proposed to the National Convention the establishment of a Board of Longitude, in imitation of the British Board, and to which should be confided the publication of the *Connoissance des Tems*. From that time to the present it has been published with greater regularity, and in general about the same time as the *Nautical Almanac*; for, from some cause or other, the latter has not appeared so many years in advance as in the times of Maskelyne. Considering that the work is sometimes wanted for long voyages of

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discovery, its publication 3 or 4 years in advance, instead of 2¼ years, as at present, would certainly be desirable. From the time of Maskelyne's editing the *Nautical Almanac* till his decease, it gained the approbation of his countrymen and the eulogies of foreign astronomers. La Lande, speaking of it, says, "*On a fait à Bologne, à Vienne, à Berlin, à Milan; mais le 'Nautical Almanac' de Londres est l'éphéméride la plus parfaite qu'il y ait jamais eu.*"

On the death of Maskelyne, the superintendence of it passed into the hands of "irresponsible" persons, and the character which it had so long sustained was lost. Compared with corresponding productions of other countries, it was not only inaccurate but incomplete. Astronomical knowledge was progressive; but the *Nautical Almanac* remained not only stationary, but retrograded. To restore it to its former rank, a new Board of Longitude was formed, and the superintendence of the Almanac was confided to the Secretary of the Board. To retrieve the character of a work which, from holding the highest rank in the ephemerides of Europe, had descended below mediocrity, was no easy task; but it is due to the memory of that eminent person to acknowledge, that the first volumes published under his superintendence did much to restore its character for accuracy. Other ephemerides, however, having, in an astronomical point of view, got the start of it, sustained their superiority; and there is scarcely an observatory in the country upon whose desks have not been found, for several years past, the ephemerides of France, of Berlin, and of Milan. As a small addition, a supplement has been recently published; this, however, gets into circulation not till its year is actually commenced, and therefore is comparatively of little use. Under these circumstances, so injurious to the astronomical character of the country, many have been the discussions relative to the *Nautical Almanac*, and the individual who has the honour to address you has not been unconcerned in them. His animadversions may have been occasionally severe, but he hopes never unjust;—they were intended to convince, not unnecessarily to wound. For the individual with whom he had the misfortune to differ, he entertained the highest respect; and by no one even of his scientific friends, was his premature removal more keenly felt than by him, who never differed from him but with regret. His acquirements were of no common order; and whatever may be our opinions of his superintendence of the *Nautical Almanac*, all suffrages will unite in pronouncing him an ornament to his country.

Since the decease of Dr. Young, the superintendence of the Almanac has been transferred to the Astronomer Royal, and the volume for 1832 has just been published under his direction. No important alteration distinguishes it from its predecessors. Almost on the same day appeared the corresponding volume of the *Connoissance des Tems*. The former gives us no notice of improvements contemplated for future volumes; the latter promises

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some important additions. I have, however, the satisfaction of announcing to the Society the following message from the First Lord of the Admiralty, transmitted to me through the Hydrographer; namely, "that the Admiralty has actually ordered some additions to the Almanac for 1833, and has it in contemplation to order further additions to that for 1834." What these additions are, it has not been thought proper to divulge, at least to me; let us therefore hope that they will be worthy of the country, and that ere long the *Nautical Almanac and Astronomical Ephemeris of Great Britain*, rising like a phœnix from its ashes, shall be as much superior to Encke's, as Encke's is now superior to it. That, however, will be no easy task: Encke, whose name stands already in the list of those to whom our medal has been *before* adjudged, is no ordinary rival. Well knowing what is wanted in an observatory—skilled in practice—profound in theory—and living under a government by which science is *eminently* encouraged—he has given to us an ephemeris, which is invaluable. To enter into its individual merits would far exceed the time allowed me; suffice it to say, that for every purpose of astronomical investigation, its materials are sterling, and its arrangement excellent. With it, an observatory scarcely wants a single book; without it, every one.

(*The President then, addressing Mr. Baily, said:*—)

Mr. Baily,—To no one can I confide this medal with more propriety than to you; for no one, more than you, knows the importance of our associate's labours. Transmit it to him as a second badge of our regard; and tell him, that for his Ephemeris we are under obligations to him, which we never can repay.

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